1a. Write down the range of \( f \). 

**Markscheme**

correct range (do not accept 0 \( \leq x \leq 7 \))  \( A1 \ N1 \)

eg \([0, 7], 0 \leq y \leq 7\)  \( [1 \ mark] \)

1b. Write down \( f(2) \);  

[1 mark]
1c. Write down $f^{-1}(2)$.

$\text{Markscheme}
\begin{align*}
 f(2) &= 3 & \text{A1 N1} \\
 [1 \text{ mark}] 
\end{align*}$

1d. On the grid, sketch the graph of $f^{-1}$.

$\text{Markscheme}
\begin{align*}
 f^{-1}(2) &= 0 & \text{A1 N1} \\
 [1 \text{ mark}] 
\end{align*}$
Notes: Award A1 for both end points within circles, A1 for images of (2, 3) and (0, 2) within circles, A1 for approximately correct reflection in $y = x$, concave up then concave down shape (do not accept line segments).

[3 marks]

Let $f(x) = 5x$ and $g(x) = x^2 + 1$, for $x \in \mathbb{R}$.

2a. Find $f^{-1}(x)$. [2 marks]

Markscheme

interchanging $x$ and $x$ (M1)

eg $x = 5y$

$f^{-1}(x) = \frac{x}{5}$ A1 N2

[2 marks]

2b. Find $(f \circ g)(7)$. [3 marks]
**Markscheme**

**METHOD 1**

attempt to substitute 7 into \( g(x) \) or \( f(x) \) \((M1)\)

\[ eg \quad 7^2 + 1, \quad 5 \times 7 \]

\( g(7) = 50 \quad (A1) \)

\( f(50) = 250 \quad A1 \quad N2 \)

**METHOD 2**

attempt to form composite function (in any order) \((M1)\)

\[ eg \quad 5(x^2 + 1), \quad (5x)^2 + 1 \]

correct substitution \((A1)\)

\[ eg \quad 5 \times (7^2 + 1) \]

\[ (f \circ g)(7) = 250 \quad A1 \quad N2 \]

[3 marks]

Let \( f(x) = x^2 - 1 \) and \( g(x) = x^2 - 2 \), for \( x \in \mathbb{R} \).

3a. Show that \((f \circ g)(x) = x^4 - 4x^2 + 3\). \([2 \text{ marks}]\)

**Markscheme**

attempt to form composite in either order \((M1)\)

\[ eg \quad f(x^2 - 2), \quad (x^2 - 1)^2 - 2 \]

\[ (x^4 - 4x^2 + 4) - 1 \quad A1 \]

\( (f \circ g)(x) = x^4 - 4x^2 + 3 \quad AG \quad N0 \)

[2 marks]
3b. On the following grid, sketch the graph of \((f \circ g)(x)\), for \(0 \leq x \leq 2.25\). [3 marks]

Note: Award \textit{A1} for approximately correct shape which changes from concave down to concave up. Only if this \textit{A1} is awarded, award the following:
- \textit{A1} for left hand endpoint in circle \textbf{and} right hand endpoint in oval,
- \textit{A1} for minimum in oval.

[3 marks]
3c. The equation $(f \circ g)(x) = k$ has exactly two solutions, for $0 \leq x \leq 2.25$. Find the possible values of $k$. [3 marks]

**Markscheme**

- evidence of identifying max/min as relevant points  \((M1)\)
  - eg $x = 0, 1.41421, y = -1, 3$
- correct interval (inclusion/exclusion of endpoints must be correct)  \((A2)\) \((N3)\)
  - eg $-1 < k \leq 3, [-1, 3], (-1, 3)$

Let $f(x) = (x - 5)^3$, for $x \in \mathbb{R}$.

4a. Find $f^{-1}(x)$. [3 marks]

**Markscheme**

- interchanging $x$ and $y$ (seen anywhere)  \((M1)\)
  - eg $x = (y - 5)^3$
- evidence of correct manipulation  \((A1)\)
  - eg $y - 5 = \sqrt[3]{x}$
  - $f^{-1}(x) = \sqrt[3]{x} + 5$ (accept $5 + \frac{x}{3}, y = 5 + \sqrt[3]{x}$)  \((A1)\) \((N2)\)

**Notes:** If working shown, and they do not interchange $x$ and $y$, award $A1A1M0$ for $\sqrt[3]{y} + 5$.

If no working shown, award $N1$ for $\sqrt[3]{y} + 5$.

4b. Let $g$ be a function so that $(f \circ g)(x) = 8x^6$. Find $g(x)$. [3 marks]
The following diagram shows the graph of a function $f$.

5a. Find $f^{-1}(-1)$.

5b. Find $(f \circ f)(-1)$. 

The following diagram shows the graph of a function $f$.

5a. Find $f^{-1}(-1)$.

[2 marks]

5b. Find $(f \circ f)(-1)$.

[3 marks]
5c. On the same diagram, sketch the graph of \( y = f(-x) \). [2 marks]

Markscheme

Note: The shape must be an approximately correct shape (concave down and increasing). Only if the shape is approximately correct, award the following for points in circles:

\( A1 \) for the \( y \)-intercept,

\( A1 \) for any two of these points \((-5, -1), (-2, 1), (1, 2)\).

[2 marks]

Total [7 marks]
The following diagram shows the graph of 
\[ y = f(x), \text{ for } -4 \leq x \leq 5. \]

6a. Write down the value of \( f(-3) \). [1 mark]

**Markscheme**

\[ f(-3) = -1 \quad A1 \quad N1 \]  
[1 mark]

6b. Write down the value of \( f^{-1}(1) \). [1 mark]

**Markscheme**

\[ f^{-1}(1) = 0 \quad \text{(accept } y = 0) \quad A1 \quad N1 \]  
[1 mark]

6c. Find the domain of \( f^{-1} \). [2 marks]

**Markscheme**

domain of \( f^{-1} \) is range of \( f \) \( \text{(R1)} \)

eg \( \text{R}f = Df^{-1} \)

correct answer \( A1 \quad N2 \)

eg \( -3 \leq x \leq 3, \quad x \in [-3, 3] \quad \text{(accept } -3 < x < 3, \quad -3 \leq y \leq 3) \)
[2 marks]

6d. On the grid above, sketch the graph of \( f^{-1} \). [3 marks]
Note: Graph must be approximately correct reflection in \( y = x \).

Only if the shape is approximately correct, award the following:

\( A1 \) for \( x \)-intercept at 1, and \( A1 \) for endpoints within circles.

[2 marks]

The diagram below shows the graph of a function \( f \), for
\(-1 \leq x \leq 2 \).

7a. Write down the value of \( f(2) \). [1 mark]
7b. Write down the value of \( f^{-1}(-1) \).

\[ f^{-1}(-1) = 0 \]

7c. Sketch the graph of \( f^{-1} \) on the grid below.
8a. Find $h(x)$.

Let
\[ f(x) = 3x, \]
\[ g(x) = 2x - 5 \]
and
\[ h(x) = (f \circ g)(x). \]

8b. Find $h^{-1}(x)$.

Markscheme

attempt to form composite \((M1)\)
e.g. $f(2x - 5)$
\[ h(x) = 6x - 15 \quad A1 \quad N2 \]

\([2 \text{ marks}]\)

[3 marks]
Markscheme

interchanging \( x \) and \( y \) \((M1)\)

evidence of correct manipulation \((A1)\)

e.g. \( y + 15 = 6x \), \( \frac{x}{6} = y - \frac{5}{2} \)

\( h^{-1}(x) = \frac{x+15}{6} \) \( A1 \) \( N3 \)

[3 marks]

Let \( f \) be the function given by

\[ f(x) = e^{0.5x}, \]

\( 0 \leq x \leq 3.5 \). The diagram shows the graph of \( f \).

9a. On the same diagram, sketch the graph of \( f^{-1} \). \([3 \text{ marks}]\)

Markscheme

\[ A1A1A1 \quad N3 \]

Note: Award \( A1 \) for approximately correct (reflected) shape, \( A1 \) for right end point in circle, \( A1 \) for through \((1, 0)\).
9b. Write down the range of $f^{-1}$.

**Markscheme**

\[ 0 \leq y \leq 3.5 \quad A1 \quad N1 \]

[1 mark]

9c. Find $f^{-1}(x)$.

**Markscheme**

interchanging $x$ and $y$ (seen anywhere) \( M1 \)

e.g. $x = e^{0.5y}$

evidence of changing to log form \( A1 \)

e.g. $\ln x = 0.5y$, $\ln x = \ln e^{0.5y}$ (any base), $\ln x = 0.5y \ln e$ (any base)

\[ f^{-1}(x) = 2 \ln x \quad A1 \quad N1 \]

[3 marks]